

A SYSTEMATIC STUDY OF *COENIA* AND *PARACOENIA* (Diptera: Ephydriidae)

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ABSTRACT.— Shore flies of the genera *Coenia* Robineau-Desvoidy and *Paracoenia* Cresson are revised, resulting in the description of two new subgenera of *Paracoenia*, *Calocoenia* and *Leptocoenia*, and of four new species, *Paracoenia ampla*, *P. calida*, and *P. wirthi* from California, and *Coenia alpina* from Labrador, Canada. Biological information on *P. turbida* and *P. calida* is given and the known distribution for each species is presented. *P. paurosoma* is reported from the Palearctic Region for the first time based on specimens from Sweden; several new distribution records from North America are also included. Characters of the male postabdomen are used, and the male genitalia of each species are illustrated. Keys or references to all known species of these genera are included.

INTRODUCTION AND REVIEW

Shore flies of the ephydrid genera *Coenia* Robineau-Desvoidy and *Paracoenia* Cresson are common and widely distributed in the Holarctic region. Typically, flies of both genera are associated with semiaquatic or aquatic environments and many tolerate a diverse range of seemingly inhospitable habitats. They are often abundant around mineral or hot springs, alkaline lakes, and marginal aquatic areas where the water is highly saline. This study was initiated to further the systematic knowledge of these unique flies and to provide a basis for detailed biological investigations.

A synoptic series on the North American Ephydriidae was started by Ezra T. Cresson, Jr. (1942, 1944, 1946, 1949), whose papers reviewed most Nearctic genera of the subfamilies Psilopinae, Notiphilinae, and Parydrinae. His untimely death precluded the completion of this series and left the synoptic study of the subfamily Ephydrinae largely unfinished until Sturtevant and Wheeler's review in 1954. This review was the last comprehensive treatment of the genera considered here.

Prior to Sturtevant and Wheeler's paper, the American species of *Coenia* or *Paracoenia* had not been treated together. Coquillet (1902) and Curran (1927) described the first Nearctic species, *Coenia bisetosa* and *C. turbida* respectively, and Johnson (1925) included *C. palustris* (Fallén) in his list of Ephydriidae from Massachusetts. Johnson's identification of the latter species as *C. palustris* is questionable, and Sturtevant and Wheeler include this citation under *C. curvicauda* Meigen. After studying the Ephydriinae in the

Naturhistorisches Museum, Wien, Cresson (1930) reviewed the European species of *Coenia*. He distinguished *C. curvicauda* from *C. palustris* and designated a lectotype for *C. curvicauda*. Cresson (1935) described a new genus, *Paracoenia*, that included two new species, *platypelta* and *fumosalis*, in addition to *Coenia bisetosa* and *C. turbida*, described previously from North America, and two European species, *C. fumosa* (Stenhammar) and *C. beckeri* (Kuntze). *C. curvicauda* and *C. palustris* were left in the genus *Coenia*. Sturtevant and Wheeler described one additional species, *C. paurosoma*, in their review of 1954.

Cresson delimited *Paracoenia* from other genera based on comparative differences he noted in the dimensions of the head, in the number of dorsocentral bristles (three in *Coenia*, four in *Paracoenia*), and in the presence (*Paracoenia*) or absence (*Coenia*) of well-defined humeral bristles. Most specialists have continued to recognize both *Coenia* and *Paracoenia* as valid genera. Dahl (1959) studied the male genitalia of both genera and suggested that the marked differences between them supported Cresson's view. The two genera were also recognized by Wirth (1965) in the catalog of North American Diptera. Sturtevant and Wheeler, however, recognized only *Coenia*, relegating *Paracoenia* to subgeneric status.

This revision is based primarily upon a comparative study of the male postabdomen and a reevaluation of previously recognized characters. From these studies, I generally concur with Cresson's concept of *Coenia* and *Paracoenia*; however, I now recognize three subgenera in the latter genus, *Paracoenia*, *Calocoenia*, and

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Leptocoenia. The basis for these proposals will be treated in greater detail in the sections on phylogeny and under the appropriate generic discussions. Four new species are described, three in *Paracoenia* and one in *Coenia*.

ACKNOWLEDGMENTS

This study was initially suggested by Dr. Stephen L. Wood while I was an undergraduate at Brigham Young University. Many of the preliminary observations were completed then, although the study has since been expanded as new species were discovered and specimens were examined from a wider geographic area. I thank Dr. Wood for his encouragement and for sponsoring two summers of field work.

Special thanks are extended to Dr. Paul H. Arnaud, California Academy of Sciences, to Dr. Willis W. Wirth, Systematic Entomology Laboratory, ARS, USDA-National Museum of Natural History, Washington, D.C., and to Mr. Guy E. Shewell, Canadian National Collection of Insects, for their extensive cooperation and assistance.

Type specimens were borrowed from the Academy of Natural Sciences of Philadelphia (Drs. David C. Rentz and Selwyn S. Roback); the National Museum of Natural History (Dr. W. W. Wirth); and the Museum of Comparative Zoology (Mrs. Janice C. Scott and Dr. John F. Lawrence).

In addition to the above, the following institutions and curators kindly loaned specimens without which this study could not have been completed: University of Minnesota (Dr. Philip J. Clausen); Kent State University (Dr. B. A. Foote); University of California, Riverside (Dr. Saul I. Frommer); Los Angeles County Museum of Natural History (Dr. Charles L. Hogue); Iowa State University (Dr. Robert E. Lewis); Cornell University (Dr. L. L. Pechuman); University of California, Davis (Dr. R. O. Schuster); Washington State University (Dr. William J. Turner); Florida State Collection of Arthropods (Dr. Howard V. Weems, Jr.); and Brigham Young University (Dr. Stephen L. Wood). Dr. Marshall R. Wheeler generously loaned specimens from his private collection.

I also wish to gratefully acknowledge

Drs. John D. Lattin, Carol A. Musgrave, Paul Oman, and Paul O. Ritcher, Oregon State University, for their technical and editorial assistance and for many stimulating discussions on systematics. The stereoscan electron micrograph was taken by Mr. Alfred Soeldner, Oregon State University. Dr. Willis W. Wirth, USDA-USNM was also kind enough to review this study.

METHODS AND DISCUSSION OF CHARACTERS

All observations were made using a stereomicroscope; a filar micrometer was used for the measurements. Morphological characters, especially those of the male postabdomen, were illustrated using an ocular grid. All illustrations were drawn to the same scale on mylar drafting film. Preparation of the male or female postabdomen for study involved its removal and heating in a 10 percent sodium hydroxide solution to remove extraneous tissue. The abdomen was then washed, further dissected, and compared. For permanent storage the abdomens were preserved in plastic microvials filled with glycerin and attached to the appropriate specimen.

During the course of the study, I examined approximately 4,000 specimens, including the type specimens of all but *Coenia curvicauda*, and I did examine European specimens of this species. The type specimens examined formed the basis for the species descriptions.

Species descriptions are purposefully brief; for the most part they summarize specific differences or additions not found in the more detailed generic descriptions. The diagnoses will differentiate the species from similar taxa. For previously recognized species, the descriptions also contain any newly acquired information for comparative purposes. Polymorphic and polytypic variations are included under remarks.

Characters considered in this study are from all body tagma and have been quantified where appropriate. Ratio values are based on an average of ten specimens selected because of obvious size differences.

HEAD.—*Eye-to-check ratio*. This is the ratio of genal height to eye height. Measurements are taken from the head in profile. This ratio is a convenient character for some species groups.

Width-to-height ratio. This ratio is calculated as head height to head width; measurements are made from a cephalic orientation.

Eye-width-to-face-length ratio. This ratio is based on measurements from the head in profile and is calculated as face length to eye width.

Height-to-length ratio. This is the ratio of the height of the head in profile to its length, measured from the most anterior surface of the face to the posterior margin of the eye. Cresson first used this character when describing *Paracoenia*.

Aristal pectinations. The length of the pectinate branches on the dorsum of the arista is compared with the base width of the arista. This character is sometimes difficult to use and is best seen in well-preserved specimens.

Interfoveal hump and marginal bristles. This character is correlated with the eye-to-cheek ratio. It is the comparison of the hump height to the length of the bristles along the oral margin. Hump height is related to genal height.

Facial color. This character is subject to considerable variation in many species, especially species of *Paracoenia*, but it is of some diagnostic value in others. The species of *Coenia* and *Calocoenia* have relatively constant facial color.

Postocular bristles. The development of the dorsalmost postocular bristles is useful in distinguishing *Paracoenia* from *Coenia*.

THORAX.— *Acrostichal hairs.* The arrangement and degree of development of the acrostichal hairs have been overlooked as a diagnostic character other than at the species level. These characters are important in distinguishing the subgenera of *Paracoenia*.

Dorsocentral bristles. The number of dorsocentral bristles has been extensively used as a major character and was accorded significance at the generic level by Cresson.

Humeral bristles. The presence or absence of well-developed humeral bristles also was used by Cresson to delimit these genera. I have followed Cresson in attributing generic importance to this character as well as to the number of dorsocentral bristles.

Halters. The color of the halters can be used to distinguish some groups of spec-

ies. Cresson (1930) mentioned that this character is usually variable and is not important as a key character.

Costal vein ratio. This is the ratio of distance along the coastal margin between R_1 and R_{2+3} to the distance between R_{2+3} and R_{3+4} . All measurements are the maximum straight-line distances.

M_{1+2} ratio. This is the ratio of the distance of the M_{1+2} anterior to the posterior cross vein to the distance posterior to the posterior cross vein.

Costal bristles. The presence or absence of costal bristles along the dorsal and/or ventral surface is diagnostic of some genera. *Calocoenia* is the only taxon of Scatellini with prominent bristles on both surfaces, a character found in many species of Ephydrini.

Femoral comb. The femoral comb is a sexually dimorphic character restricted to the males of *Paracoenia* s. str.

ABDOMEN.— *Male postabdomen.* The male genitalia previously have not been used as characters at the species or generic level; I have found them extremely useful at both levels. These characters are discussed more fully in the generic and specific descriptions.

Female ventral receptacle. The shape of this structure seems to be of considerable diagnostic value, especially at the generic level.

PHYLOGENY AND CLASSIFICATION

Both *Coenia* and *Paracoenia* belong to Scatellini as it is presently characterized. The tarsal claws are curved and short, and the pulvilli are developed normally. The tribal concepts, however, have not been reassessed since Wirth (1948, 1970, 1971), Oliveira (1954a, 1954b, 1957), and others (Collin, 1963; Steyskal, 1970) began incorporating characters of the male postabdomen in their treatments of various Ephydrinae genera. This is especially evident with the annectant genus *Austrocoenia* Wirth from South America as well as several undescribed genera from the neotropics, which will require further evaluation before a reliable classification of the higher categories can be achieved. Biological information and systematic studies of the immature stages would also be most useful.

Because biological and morphological data of the larvae are lacking in many re-

lated genera and in some of the taxa herein considered, I have elected to recognize a conservative classification in this study. Taxa above the species level but within the generic limits of *Paracoenia* as Cresson described it are given subgeneric status. But this status is provisional, awaiting the accumulation of additional information as outlined above and further assessment.

The subgenera of *Paracoenia* are primarily based on characters of the male postabdomen and correlated external features. The resulting concepts are sufficiently distinct to be easily recognizable as delimited in the diagnoses and as seen by reviewing the figures. *Paracoenia* (*Paracoenia*), for example, is the largest subgenus with eight species, yet each known taxon belonging to this category can be readily placed without difficulty. Further, most of the diagnostic charac-

ters are apomorphic and define monophyletic groups.

On the other hand, the relationships between subgenera are somewhat obscure and the generic concept is not as neatly circumscribed. More reliance is placed on chaetotaxy characters of doubtful significance. However, coupled with our meager knowledge regarding biology, habitat, etc., I feel that the genus is convenient and does reflect a cohesive unit.

Coenia has only three species, all of which are evidently closely related. Except by association with males and in some instances with locality, the females of one species are generally indistinguishable from those of another. Similarly, the males closely resemble each other, although their genitalic characters are consistent and constant, a fact that facilitates identification and classification. This group in particular needs biological study.

TAXONOMY

Key to *Coenia* and *Paracoenia*

1. Four pairs of dorsocentral bristles; humeral bristles well developed; dorsal-most postocular bristles subequal to verticals *Paracoenia* Cresson
- Three pairs of dorsocentral bristles; no developed humeral bristles; dorsal postocular bristles much smaller than verticals *Coenia* Robineau-Desvoidy

Genus *Paracoenia* Cresson

Paracoenia Cresson, 1935, Trans. Amer. Ent. Soc. 61:356. Type-species, *Coenia bisetosa* Coquillett, by original designation. Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79:164-166 (review of Nearctic species as subgenus of *Coenia*). Wirth, 1965, USDA Agricultural Handbook No. 276, pp. 755-756 (catalog).

DIAGNOSIS.—Members of this genus are similar to those of *Coenia* but can be distinguished from the latter as follows: Postocular bristles immediately posterior to the vertical bristles subequal to verticals; at least one humeral bristle well developed, much larger than the surrounding setae; four pairs of dorsocentral bristles.

DESCRIPTION.—Small to large, length 2.1 to 4.4 mm, females usually larger than males; dark species, often with subshining metallic reflections; head with characteristic arched prefrons.

Head. Front (postfrons) rectangular, wider than long; margins of mesofrons directed inward anteriorly; mesofrons subshining with metallic reflections, setulose; ocellar triangle equilateral, concolor-

ous with fronto-orbital areas, dull, microsculptured. One large pair of proclinate diverging ocellar bristles; postvertical bristles various; two pairs of fronto-orbital bristles; both inner and outer vertical bristles well developed; two pairs of strong postocular bristles immediately posterior to vertical bristles. Antennae dark brown to black, pollinose; second segment setulose, especially on median and ventral surfaces; dorsum of arista pectinate, pectinate branches up to three times the width of arisal base, sometimes equaling third antennal segment width. Pruinosity face (prefrons) protruding, arched with interfoveal hump, setulose; setae descending from hump and along ventral margin strongest. Eye suboval; gena variously developed with genal bristle toward ventral margin. Mouthparts dark; prementum large, bulbous.

Thorax. Dorsum of mesonotum subshining to dull, generally concolorous, sometimes with discernible median and lateral stripes. Acrostichal hairs in approximately six irregular rows to two distinct rows; four pairs of dorsocentral bristles

les; one pair of intra-alars; two to three pairs of humeral bristles; two pairs of notopleurals; one pair of presuturals; one pair of supra-alars; two pairs of post-alars; dorsum of scutellum convex to flat, setulose; at least two well-developed pairs of lateral scutellar bristles; one pair each of mesopleural and sternopleural bristles. Wings transparent to infuscated; costal setae weak to strong, on dorsal and/or ventral margins. Legs dark, pollinose to subshining.

Abdomen. Abdomen of males with five visible tergites, females with six to seven, subshining to pollinose; most species with pollinose band near the posterior margin of each tergite; fifth abdominal tergite of males with anteroventral projection in some species of *Paracoenia* s. str. Female postabdomen with three complete segments, six, seven, eight; ninth segment with tergite not fused dorsally, with one pair of long spines on ventral margin; sternite of ninth segment also with one pair of spines; female abdomen terminating with cerci. Ventral receptacle variously shaped. Male postabdomen symmetrical, reduced; sixth segment with spiracles only although European species of *Paracoenia* s. str. have a transverse sclerotized band posterior to fifth sternite which could represent sixth sternite; seventh and eighth segments absent. Spiracles one through six present, sixth spir-

acle in membrane between fifth abdominal tergite and epandrium, all other spiracles in ventral margin of respective tergites. Epandrium suboval with scattered setae; dorsum of epandrial plate bearing two setulose cerci; ventrally epandrium terminates at juncture with prominent, projecting surstyli of various shapes. Hypandrium extending dorsally and ventrally, attaching to epandrium, lateral hypandrial process sheathing aedeagus; aedeagus well sclerotized, pointed apically.

DISCUSSION.— For purposes of classification the species of *Paracoenia* are arranged in three subgenera, *Paracoenia*, *Calocoenia*, and *Leptocoenia*. The latter two subgenera might be accorded generic status by future revisers since the male postabdomens and other characters are fairly distinctive. But before the generic classification of these taxa is assessed, the higher classification of the subfamily Ephydrinae should be revised on a worldwide basis to insure consistency in generic concepts, especially the distinguishing gap. Such a review will necessarily entail a great deal of descriptive work because of our spotty knowledge of many faunal areas, i.e., the Neotropical Region, which are replete with undescribed species.

The following key works best for male specimens and includes both European species. Illustrations of the male genitalia will facilitate accurate identification.

Key to *Paracoenia* subgenera and species

1. Acrostichal hairs in two rows; dorsum of scutellum slightly convex to flat; posteroventral margin of mesofemora without row of comblike bristles in males 2
- Acrostichal hairs in four to six irregular rows; dorsum of scutellum convex; posteroventral margin of mesofemora with dense row of bristles in males subgenus *Paracoenia* Cresson 3
2. Length over 3.25 mm; eye-to-cheek ratio 1:0.25 or larger; well-developed costal bristles projecting anteriorly from ventral and dorsal surfaces subgenus *Calocoenia*, *Calocoenia platypelta* (Cresson)
- Length under 3.00 mm; eye-to-cheek ratio 1:0.25 or less; bristles along costal margin not developed subgenus *Leptocoenia*, *Leptocoenia paurosoma* (Sturtevant and Wheeler)
3. Fifth abdominal sternite of male deeply U-shaped, Figs. 11, 12; Palearctic 4
- Fifth abdominal sternite broadly U-shaped, Figs. 1-6; Nearctic 5
4. Length approximately 5 mm; dorsum of thorax and abdomen grayish-blue to light brown, dull; pleura gray *P. beckeri* (Kuntze)
- Length usually less than 4 mm; thorax and abdomen darker, bluish-olive green to greenish-gray; subshining dorsally *P. fumosa* (Stenhammar)

5. Postocellars small, no longer than their distance apart at base; facial pruinosity yellowish-gold with greenish-blue metallic reflection showing through around interfoveal hump; ventral projection of fifth abdominal tergite in males blunt, parallel to remainder of ventral margin *P. fumosalis* Cresson
- Postocellars larger, longer than their distance apart at base, facial pruinosity various; ventral projection of fifth abdominal tergite absent or not as above 6
6. Process of fifth abdominal tergite in males not developed 7
Process of fifth abdominal tergite developed into a projection of various shapes 8
7. Subshining with metallic blue reflections; eye-to-cheek ratio 1:0.45 or larger; associated with hot sulfur springs *P. calida* n.sp.
Subshining with metallic green reflections; eye-to-cheek ratio 1:0.3 or less; associated with thermal or cool water *P. turbida* (Curran)
8. Process of fifth abdominal tergite of male broadly produced; acrostichal hairs few; male genitalia as in Fig. 1; presently known only from vicinity of Los Angeles, California *P. ampla* n. sp.
Process of fifth abdominal tergite not as broadly produced; acrostichal hairs stronger; surstyli of male genitalia not pointed distally or bare 9
9. Surstyli thickened basally, at least one-half total length; sheathing projection of hypandrium broadly rounded apically; smaller, length 3.1-3.6 mm; setation less well developed, especially on face and mesonotum; male genitalia as in Fig. 6 *P. wirthi* n. sp.
Basal expansion of surstyli less than one-third total length; lateral process of hypandrium pointed; length 3.7-4.4 mm; facial and mesonotal hairs well developed *P. bisetosa* (Coquillett)

Subgenus *Paracoenia* Cresson

Paracoenia Cresson, 1935, Trans. Amer. Ent. Soc. 61:356. Type-species *Coenia bisetosa* Coquillett, by original designation. Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79:164-166.

DIAGNOSIS.— This subgenus is similar to *Calocoenia* but may be distinguished as follows: acrostichal hairs in several irregular rows, no prominent hairs; dorsum of scutellum convex; costal setae weak, in a single row; posteroventral margin of mesofemora with distinct row of bristles in males; many species with an anteroventral projection of the fifth abdominal tergite; epandrium of male with an anteromedian triangular projection; aedeagal apodeme subquadrate.

DESCRIPTION.— Moderately large, length 3.1-5.0 mm; dark species, often with subshining metallic reflections.

Head. Front rectangular; mesofrons subshining to shining with metallic reflections; pectinate branches of arista up to three times the width of arisal base, often equaling third antennal segment width. Face with prominent interfoveal

hump, strongly arched; eye-to-cheek ratio usually 1:0.22-0.45; width-to-height ratio 1:0.67; eye-width-to-face-length ratio 1:0.45 (1:0.85 in *P. calida*); height-to-length ratio 1:0.93.

Thorax. Dorsum subshining although subdued in aged specimens, generally shining more posteriorly. Acrostichal hairs in four to six irregular rows; otherwise chaetotaxy as in generic description; scutellum convex. Costal vein ratio 1:0.2; M_{1+2} vein ratio 1:0.90; costal setae generally weak, developed setae on dorsal margin only. Mesofemora of males with posteroventral row of comblike bristles.

Abdomen. Subshining to pollinose, if shining, reflection somewhat less than dorsum of scutellum. Female ventral receptacle with operculum, wider than high, extending process not longer than operculum length. Surstyli of male postabdomen projecting from lateral margins of epandrium, long, variously shaped; a triangular process lies between surstyli, some species, with a median groove (see figures of included species).

DISCUSSION.— The species included in

this taxon form a fairly homogeneous group based mostly on apomorphic characters (see diagnosis). The joint possession of these characters delimits the monophyletic grouping here understood as *Paracoenia* s. str. and determines the subgeneric concept. Two species previously included here, *P. paurosoma* (Sturtevant and Wheeler) and *P. platypelta* Cresson, are sufficiently distinct to form the basis for new subgenera.

Paracoenia s. str. is Holarctic, but no one species is presently known to occur in both Eurasia and North America. However, many species of the subgenus are widely distributed, and it is not uncommon to collect two or more species from the same general locality. Other species such as the Nearctic *P. calida* and *P. ampla* and the Palearctic *P. beckeri* are known only from very localized geographic areas.

The subgenus contains eight species; six are Nearctic and two are Palearctic. All of the Nearctic species except *P. fumosalis* are found principally in western North America. A more detailed zooge-

graphic account, aside from the general distributions indicated under the appropriate species, will not be possible until more collection data become available.

The paucity of biological studies precludes a detailed accounting for the entire subgenus. For the Nearctic region, only *P. turbida* has been studied in any detail (Brock et al., 1968, 1969). However, Dr. B. A. Foote and associates at Kent State University and Dr. Karl W. Simpson of Cornell University are currently engaged in studies of various ephydrid species that will greatly enhance our biological knowledge.

Most species can tolerate harsh environments, especially aquatic habitats with high concentrations of various salts. These shore flies are often abundant, for example, along the margin of Great Salt Lake or associated with hot sulfur springs in Yellowstone National Park, Wyoming. Scheiring and Foote (1973) further report finding larvae in the shoreline mud of alkaline lakes and in sewage-impregnated mud. The larva and pupa of *P. fumosa*, a Palearctic species, were described by Beyers (1939).

Paracoenia (Paracoenia) ampla, n. sp.

Fig. 1, Map 1

DIAGNOSIS.— Although this species is quite similar to *P. bisetosa*, it can be readily distinguished from the latter by comparing male postabdomens. The surstyli of *P. ampla* are sinuate, bare, and strongly narrowed apically. Further, the shape of the lateral hypandrial process is distinctive, especially the clavate extension. This species is larger than most *P. bisetosa* and in general is less setulose. The acrostichal hairs, in particular, are weak and widely scattered.

DESCRIPTION.— Length approximately 4.0 mm (the abdomen was removed for dissection before measurements were taken); generally subshining with bluish-green metallic reflections.

Head. Width-to-height ratio 1:0.7; height-to-length ratio 1:1; eye-width-to-face-length ratio 1:0.44; facial pruinosity brownish-gold.

Thorax. Setae generally weak, scattered; costal vein ratio 1:0.17; M_{1+2} ratio 1:1.

Abdomen. Fifth tergite ventrally produced into broadly based processes that extend anteriorly to basal margin of fused



Map 1.— Distribution of *Paracoenia wirthi*, filled stars; *Paracoenia platypelta*, filled circles; *Paracoenia ampla*, open circle; and *Paracoenia calida*, open star.

U-shaped fourth and fifth abdominal sternites, processes pointed apically; fifth abdominal sternite thin, weak, deeply U-shaped with parallel arms; epandrium subquadrate; medial triangular projection proportionately small to epandrial size; surstyli directed inward, apically narrowed, sinuate, bare; hypandrium in profile almost rectangular, with extending process slightly clavate; aedeagus broad basally, tapering rapidly, curved and pointed apically. Male genitalia as in Fig. 1.

DISTRIBUTION.— Los Angeles, California.

TYPES.— Male holotype with the following label data: Los Angeles, Cal., Apr 29th, 1915, M. VanDuzee; a determination label, *Coenia bisetosa* Coq., 1919, Cresson; a blue M C VanDuzee collection label. The type will be deposited with the California Academy of Sciences, type number 12032.

REMARKS.— This species is known only from the unique male holotype. Recognition of the specimen as representing a new species is justified in view of the very distinctive male postabdomen. Unfortunately, *P. ampla* may already be extinct due to the tremendous and rapid urban growth in the Los Angeles area since 1915. I have examined several *Paracoenia* specimens from Los Angeles County but none were *ampla*.

Paracoenia (Paracoenia) bisetosa
(Coquillett)

Fig. 4, Map 3

Coenia bisetosa Coquillett, 1902, J. N. Y. Ent. Soc. 10:183

Caenia [sic] bisetosa: Aldrich, 1905, Smithsonian Misc. Coll. 66(1444):631

Paracoenia bisetosa: Cresson, 1935, Trans. Amer. Ent. Soc. 61:356

Coenia (Paracoenia) bisetosa: Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79:164

TYPES.— Male holotype, Salt Lake, Utah, 25 June, E. A. Schwarz collector. The type is deposited with the National Museum of Natural History, Washington, D.C., type number 6644. This specimen is in relatively good condition, although the wings are ragged and torn.

DIAGNOSIS.— *P. bisetosa* is similar to *P. turbida*, but the former is larger, more setulose, and more brownish. The poste-

rior margin of the fifth abdominal sternite is sclerotized and of uniform thickness throughout. The ventral process of the fifth abdominal tergite is well developed and pointed. Basally, the surstyli are enlarged but narrow quickly, making the lateral margin sinuate. The hypandrial process usually tapers evenly to a rounded point. Outwardly, this species might be confused with *P. ampla*, but the male genitalia of *P. bisetosa* differ sufficiently from the latter that recognition of either species should not be difficult.

DESCRIPTION.— Length 3.7-4.4 mm; dark greenish-brown dorsally; laterally quite pollinose.

Head. Mesofrons with bronze metallic reflections. Eye-to-cheek ratio 1:0.34; width-to-height ratio 1:0.69; height-to-length ratio 1:0.9; eye-width-to-face-length ratio 1:0.5.

Thorax. Dorsum with pollinose anterior, becoming subshining posteriorly; pleural areas largely pollinose. Wings infuscated with light brown.

Abdomen. As in diagnosis and Fig. 4.

SPECIMENS EXAMINED.— 1881.

DISTRIBUTION.— Like *P. turbida*, this species is primarily a western North American taxon, although collecting data indicate eastern extensions to New York (5 miles W Cardiff), Pennsylvania (Philadelphia), Delaware (Bombay Hook), and Virginia (Saltville). The Northwest Territories (Nyarlung River), Canada, is the northernmost collection site, and the species ranges from there southward through most of the Midwest to Texas (Buffalo Spring Lake) and into Mexico (Guadalupe Can., B. Calif.). Westward, specimens have been collected in every state and Canadian province west of the 100th parallel.

REMARKS.— This is the most common species of the genus and among the most widespread. It is also one of the most variable. Facial pruinosity color runs from bright brownish-orange to silver, and the general body color varies from shining greenish-brown to a subdued, grayed green. Age polymorphism is also apparent; older specimens are often more brownish and are worn.

Dr. Willis W. Wirth has made several collections of *P. bisetosa* from aquatic habitats with varying concentrations of both alkaline and saline salts.



Map 2.— Distribution of *Paracoenia fumosalis*, filled circles; *Paracoenia turbida*, filled stars; and *Coenia alpina*, enclosed stars.

Paracoenia (Paracoenia) calida, n. sp.

Fig. 3, Map 1

DIAGNOSIS.— This is the most distinctive Nearctic species and is easily separated from all others of the genus. Externally, the blue metallic reflections from the dorsum, the protruding prefrons, and the eye-to-cheek ratio are diagnostic. The male postabdomen resembles that of *P. bisetosa* but differs in the shape of the hypandrial process, which is more or less

of uniform thickness and has a noticeable taper just before the apices. Additionally, the fifth abdominal tergite does not have a ventral extension, although the margin is pointed. *P. calida* and *P. bisetosa* are approximately the same size.

DESCRIPTION.— Length 3.4-4.3 mm, holotype male 3.9 mm, generally dark, gray pollinose on head and thoracic plurae with subshining blue metallic reflections dorsally.

Head. Eye-to-cheek ratio 1:0.45; height-to-length ratio 1:1; width-to-height ratio 1:0.71; eye-width-to-face-length ratio 1:0.85. Fronto-orbital and ocellar triangle areas blackish-gray, concolorous with margins of frons; postocellar bristles weak in some specimens; pruinose face grayish-tan.

Thorax. Pleural areas dull, pollinose; dorsum subshining to shining, brownish-blue; halteres dark, reddish-brown to black; wings completely infuscated, brown to smoky. Tarsal claws well developed, as long as third or fourth tarsomere; pulvillar pads proportionately small to claw size.

Abdomen. Dorsum of all segments with distinct blue to purplish-blue reflections, reflections stronger in general than elsewhere on body; ventral margin of fifth abdominal tergite broadly pointed, without lobelike projection; fifth abdominal sternite broadly U-shaped, narrow projecting arms forming obtuse angle; setae along posterior margins of tergites much larger than rest of setae, at least twice as long, in some female specimens three to four times as long. Surstyli of male genitalia with more or less gradual taper, not sinuate or pedunculate; aedeagus short; hypandrial process as described in diagnosis.

DISTRIBUTION.— Wilbur Hot Springs, Colusa Co., California.

TYPES.— Male holotype, allotype, and all paratypes are from the type locality. Two male and 9 female paratypes, H. J. Jacob; 1 male and 1 female paratype, 27 June 1950, L. W. Quate; holotype, allotype, and 205 male and 96 female paratypes, 25 June 1974, W. N. Mathis. Primary types will be deposited with the U. S. National Museum of Natural History, type number 72975. Male and female paratypes will be deposited with the California Academy of Sciences, Canadian National Collection, Academy of Natural Sciences of Philadelphia, Kent State University, Washington State University, and Oregon State University. The remaining paratypes are in my collection.

REMARKS.— Of all the Nearctic species of *Paracoenia* s. str., *P. calida* is perhaps the most remarkable. Its known distribution is limited to a hot sulfur spring in the foothills just east of Clear Lake, California. The larvae develop and mature in all but the hottest water where they can easily

be collected in great numbers. The adults are also abundant and were often observed to congregate in large clumps near the spring source where shaded or protected areas could be found. Empty puparia that are scattered on the surface of the effluent and along its margins are often utilized as oviposition sites. Figure 13 is a stereoscan electron micrograph of the egg of *P. calida*.

The effluent of the spring emptied into a small creek around which swarming numbers of other ephydrids were encountered on emergent grasses and in quieter eddies on the water's surface. *P. calida*, however, was not common there, and only an occasional collection was made away from the hot springs. It is also of interest that a new saldid species was recently described from the same locality (J. T. Polhemus, 1967).

The specific name, *calida*, is descriptive of the habitat.

Paracoenia (Paracoenia) fumosalis
Cresson

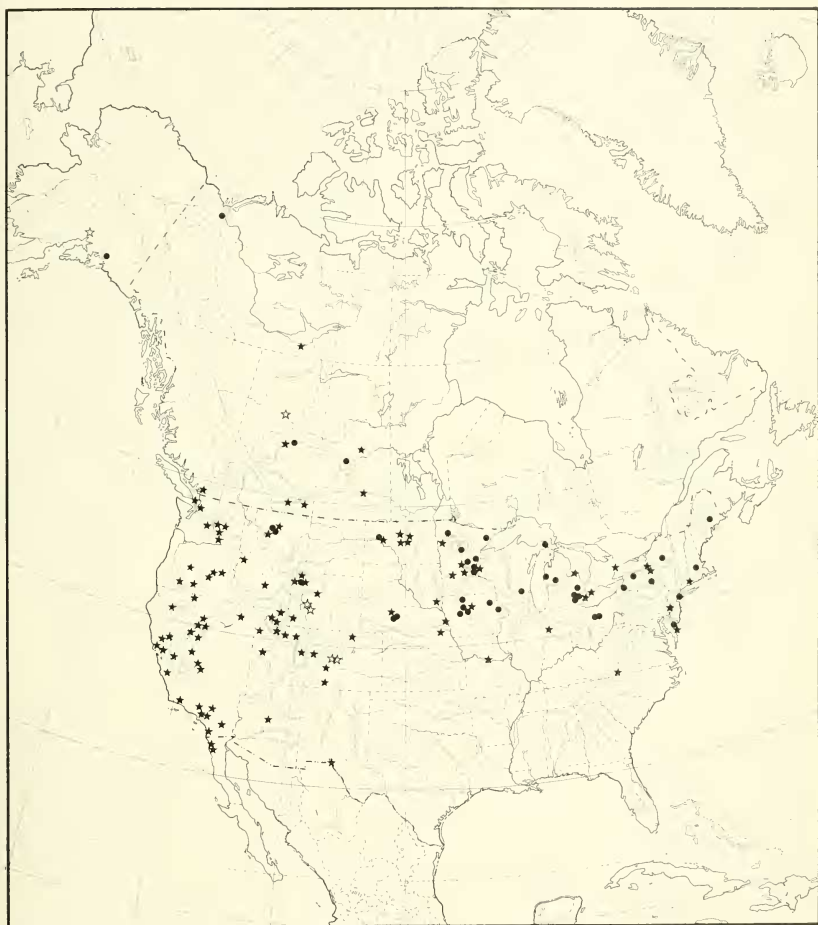
Fig. 2, Map 2

Paracoenia fumosalis Cresson, 1935, Trans. Amer. Ent. Soc. 61:356

Coenia (Paracoenia) fumosalis: Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79:164

TYPES.— Male holotype, Rockport, Massachusetts, 28 August 1913, C. W. Johnson collector. The type is deposited with the Boston Natural History Society (Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts), type number 31759. One male and two female paratypes are topotypical. Four female paratypes were collected on Nantucket Island, 13 July 1926 by C. W. Johnson. All paratypes are deposited with the Academy of Natural Sciences of Philadelphia.

DIAGNOSIS.— Cresson (1935) stated that this species is similar to *P. bisetosa* and *P. fumosa*, which is Palearctic. My observations agree with Cresson's, although in many respects *P. fumosalis* is unique among *Paracoenia* species. The males are most easily distinguished from similar taxa by the rounded, fingerlike projection of the fifth abdominal tergite. This process is parallel to the ventral margin of the tergite that is deeply incised and of uniform thickness before the slightly enlarged, rounded apex. The fifth abdomin-



Map 3.— Distribution of *Paracoenia bisetosa*, filled stars; *Coenia paurosoma*, open stars; and *Coenia curvicauda*, filled circles.

al sternite is subrectangular without extending arms from the posterolateral margins. The surstyli are narrowly S-shaped, and the median triangular process often has a median groove that is cleft apically. The hypandrial process is much longer than the aedeagus, and apically it is truncate. Externally, *P. fumosalis* differs from all others in the length of the post-ocellar bristles, which are usually shorter than their distance apart at the base.

Further, the tannish-bronze color of the pruinose face seems to be constant.

DESCRIPTION.— Length 3.5-4.0 mm; dark brown, lightly pollinose to subshining dorsally; some greenish-blue metallic reflections.

Head. Mesofrons shining with bluish reflections; fronto-orbital areas subshining brown; face concolorous with mesofrons, pruinose, tannish-bronze. Eye-to-cheek ratio 1:0.3; width-to-height ratio 1:0.64;

height-to-length ratio 1:0.87; eye-width-to-face-length ratio 1:0.41.

Thorax. Dorsally subshining, purplish-blue reflections, dark brown. Pleural areas pollinose except dorsal margin. Wings infuscated with brown.

Abdomen. Concolorous with dorsum of thorax. Male postabdomen as in diagnosis and Fig. 2.

SPECIMENS EXAMINED.— 368.

DISTRIBUTION.— *P. fumosalis* is predominantly a northern and eastern North American species. I have examined material from Alaska (Matanuska and Eagle River flats) and from all of the Canadian provinces except British Columbia and the Yukon Territory. In the continental United States, *P. fumosalis* ranges westward to Montana (Libby), eastward through the Great Lake states, some mid-western states (Nebraska, Iowa), and into the Northeast. It has also been collected as far south as Florida (Archbold Biological Station, Lake Placid), and it presumably occurs between Florida and the Northeast. Wirth (1965) lists California as the westernmost extension of *P. fumosalis*, but I have not seen specimens from California.

REMARKS.— Examination of over 350 specimens of this species from a wide selection of localities within its distribution revealed very little morphological variation. This species is very uniform except for slight artificial size differences reflecting the mode of preservation. The facial coloration seems to be a consistent diagnostic character unlike other widespread species of *Paracoenia*. I suspect that the species is quite vagile and that the apparent uniformity is due to extensive genetic exchange.

Although I do not know of any localities in which this species is associated with hot springs, it has been collected around alkaline and saline habitats. Scheiring and Foote (1973) reared specimens and report finding larvae in mud impregnated with organic sewage.

Paracoenia (Paracoenia) turbida
(Curran)

Fig. 5, Map 2

Caenia [sic] turbida Curran, 1927, Can. Ent. 59:91
Coenia (Paracoenia) turbida: Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79:165

Paracoenia turbida: Wirth, 1965, USDA Agri. Handbk. No. 276:756

TYPES.— Male holotype and allotype, Old Faithful, Yellowstone National Park, Wyoming, 30 September 1924, N. Criddle. Two male and one female paratype have the same label data as the type. All types are deposited with the Canadian National Collection, type number 2370.

DIAGNOSIS.— Externally, this species resembles *P. wirthi* and is sometimes confused with *P. bisetosa*. However, it differs from both in the shape of the hypandrial process, which apically narrows more abruptly although the apex is rounded. Also, the lateral margins of the surstyli do not taper apically as rapidly as *P. bisetosa* nor are they enlarged basally as in *P. wirthi*. Outwardly, *P. turbida* is smaller than *P. bisetosa* but of approximately the same length as *P. wirthi*. However, the acrostichal hairs are weaker in *turbida*. The fifth abdominal sternite is more similar to that of *bisetosa*, although the more sclerotized posterior margin is not as wide nor as uniform in thickness as it is in *bisetosa*.

DESCRIPTION.— Length 3.25-3.75 mm; dark greenish-brown, subshining dorsally.

Head. Fronto-orbital areas dark brown, pollinose to subshining. Eye-to-cheek ratio 1:0.3; width-to-height ratio 1:0.65; height-to-length ratio 1:0.93; eye-width-to-face-length ratio 1:0.44.

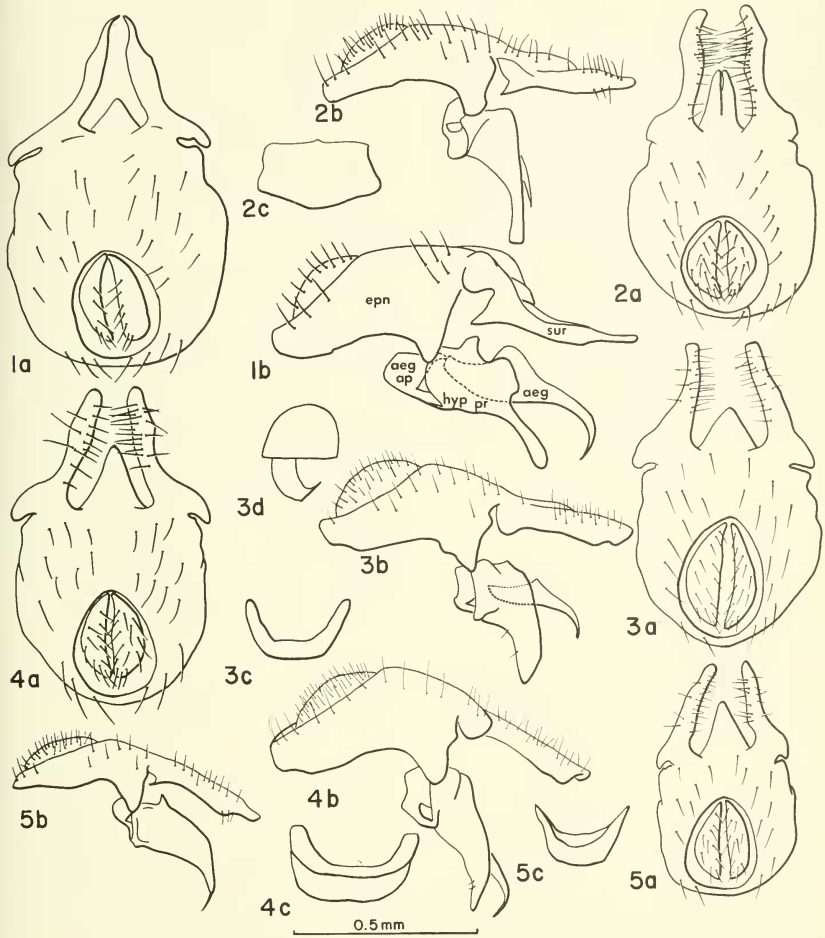
Thorax. Anterior area of dorsum slightly pollinose, becoming subshining to shining posteriorly; pleural areas in general more subdued than dorsum, especially along margins. Wings nearly transparent to light brown.

Abdomen. As in diagnosis and Fig. 5.

SPECIMENS EXAMINED.— 674.

DISTRIBUTION.— The majority of collection localities are west of the Rocky Mountains, although they do extend east to Nebraska (Cherry Co., Big Alkali Lake), Iowa (Ames), and Ohio (Kent, 5.6 miles SE). Specimens have been collected as far north as Alaska (Circle Hot Springs) and southward through Canada (British Columbia to Manitoba) and the western United States into Mexico (60 km S Tijuana).

REMARKS.— Strength of setation, general body color, especially the facial pruinosity, and overall size show considerable variability. Polymorphism within a sin-



Figs. 1-5.— Male and female genitalia. 1 a,b *Paracoenia ampla*, 2 a,b,c *Paracoenia fumosalis*; 3 a,b,c,d *Paracoenia calida*; 4 a,b,c *Paracoenia bisetosa*; 5 a,b,c *Paracoenia turbida*. Fig. a, ventral view of cerci, epandrium, and surstyli; Fig. b, lateral view of cerci, epandrium (epn), surstyli (sur), aedeagal apodeme (aeg ap), hypandrial process (hyp pr), and aedeagus (aeg); Fig. c, ventral view of male fifth abdominal sternite; Fig. d, lateral view of female ventral receptacle.

gle population of *P. turbida* seems to vary as greatly as the total species variance. Character displacement was not apparent in areas where *turbida* occurs sympatrically with other *Paracoenia* species.

Brock, et al. (1968, 1969) have studied the biology of *turbida* from near the type locality in Yellowstone National Park, Wyoming. They found that both larvae

and adults feed on blue-green algae and the filamentous bacteria of mucilaginous mats, which develop under a variety of hot spring flow conditions. Fly activity is generally restricted to cooler mats (from 30-35C), where most egg laying occurs. Above 40C the eggs fail to hatch and first instars die. At 35C the life cycle takes approximately 14 days (egg to egg),

and mature females can produce 100 or more eggs a day. *Turbida* can exploit transient islands of available resource quickly, and the larvae soon decimate the optimum habitat (Weigert and Mitchell, 1973). Wiegert and Mitchell also analyzed the interactions between the algal mats and *turbida* and between *turbida* and a mite parasite *Partnuniella thermalis* Viets. Mitchell and Redmond (1974) describe the egg of *turbida* (several stereoscan electron micrographs) and suggest mechanisms of respiration under varying environmental conditions. *Paracoenia turbida*, however, is not endemic to hot springs, and the details of their feeding habits and habitat preferences under different conditions could vary considerably. More notes on the biology of this species may be found in Scheiring and Foote (1973).

Paracoenia (Paracoenia) wirthi, n. sp.

Fig. 6, Map 1

DIAGNOSIS.— This species resembles both *P. bisetosa* and *P. turbida* and in many respects is intermediate. As in *P. bisetosa*, the ventral margin of the fifth abdominal tergite is produced into a pointed extension, but the projection is not as long as that of *P. bisetosa*. The general coloration and setal characters more resemble *P. turbida*; however, males of *P. wirthi* are distinct from either species in the shape of the surstyli, the hypandrial process, and the fifth abdominal sternite. Basally, the surstyli are wide, a condition that extends to about one-half their total length. The hypandrial process is broadly produced apically with a bluntly rounded apex. The fifth abdominal sternite is broad, and the projecting arms are subparallel and short.

DESCRIPTION.— Length 3.1-3.6 mm; subshinning with bluish-green to green metallic reflections.

Head. Mesofrons greenish-blue, shining; pruinose face grayish-tan; eye-to-cheek ratio 1:0.22; width-to-height ratio 1:0.6; height-to-length ratio 1:0.87; eye-width-to-face-length ratio 1:0.44.

Thorax. Acrostichal hairs in three to four rows anteriorly, becoming irregular with five to six rows posteriorly. Pleural areas although subdued not grayed. Wings in many specimens almost transparent, in others smoky infusate.

Abdomen. Metallic reflections green to olive green. Male genitalia as in diagnosis and Fig. 6.

DISTRIBUTION.— This species is found in the Sonoran desert from southern California and northern Baja California eastward into Arizona. It extends south into Mexico (Distrito Federal, Mixquic).

TYPES.— Male holotype, allotype and 21 paratypes (7 males, 14 females), California, Inyo Co., 1 mile N Tecopa Hot Springs, 24 June 1974, Wayne N. Mathis. Thirty-nine paratypes as follows: California, Inyo Co., Tecopa Hot Springs, 16 May 1965, W. F. Barr, 1 male; Inyo Co., Shoshone, 24 June 1974, W. N. Mathis, 1 male, 5 females; Inyo Co., Shoshone, 1 October 1935, A. J. Basinger, 1 male, 3 females; San Diego Co., Mtn. Palm Springs, Anza Desert, 2 March 1964, 1 male. Arizona, Pima Co., Lowell Ranger Station, 6-20 June 1916, 32°18.5' N, 110°49' W, ca. 2,700', 1 male, 1 female; Bill Williams Forest, August, F. H. Snow, 1 male, 1 female. Mexico, Baja California, Guadalupe Canyon, 19 May 1957, F. X. Williams, 1 male, 3 females; Distrito Federal, Mixquic, 9 km SW Chalco, 4 August 1965, K. R. Valley, 4 males, 16 females. The type, allotype, and 8 paratypes will be deposited in the California Academy of Sciences, type number 12033. The remaining paratypes will be deposited with the U. S. National Museum of Natural History, Cornell University, the Canadian National Collection, The Academy of Natural Sciences of Philadelphia, and my collection.

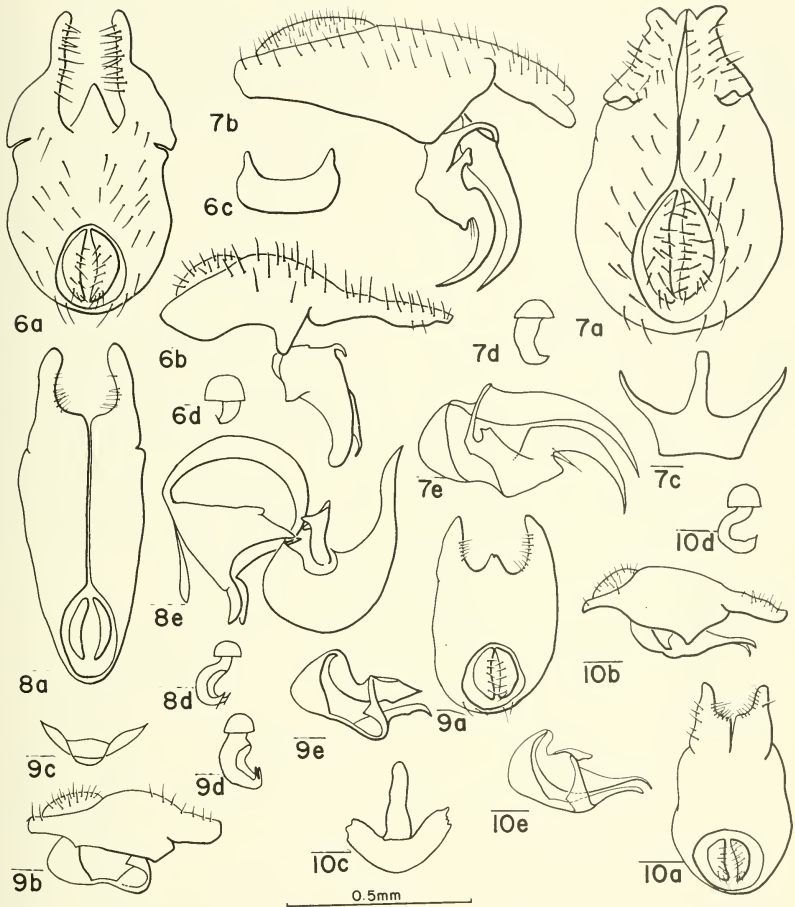
REMARKS.— Although *P. wirthi* appears to be intermediate in many characters, their consistency, especially the male genitalia, justifies recognition as a new species. As with other species of the genus, *P. wirthi* is sometimes associated with hot springs, usually along the margins of the effluent.

P. wirthi is named to honor Dr. Willis W. Wirth for his contribution to the systematics of the Ephydriidae and for his helpful, encouraging responses to my many questions.

Calocoenia, n. subgen.

Type-species: *Paracoenia platypelta* Cresson, 1935, monobasic

DIAGNOSIS.— Although similar to *Paracoenia* s. str. and *Leptoecenia*, *Calocoenia*



Figs. 6-10.— Male and female genitalia. 6 a,b,c,d *Paracoenia wirthi*; 7 a,b,c,d,e *Paracoenia platypelta*; 8 a,d,e *Coenia curvicauda*; 9 a,b,c,d,e *Paracoenia paurosoma*; 10 a,b,c,d,e *Coenia alpina*. Fig. e, lateral view of internal genitalia; others as in caption of 1-5.

may be distinguished from either as follows: Externally, *Calocoenia* differs from *Paracoenia* s. str. in the arrangement of acrostichal hairs, which are in two distinct rows, by the absence of a postero-ventral comb of bristles along the male mesofemora, by the flattened scutellum, by the prominent costal bristles projecting anteriorly from both dorsal and ventral margins, and by the generally uniform, concolorous abdomen which in male

specimens is more noticeably narrowed apically. The most apparent difference between *Calocoenia* and *Leptocoenia* is size; *Calocoenia* is nearly twice the length of most *Leptocoenia*. Further, the eye-to-cheek ratio of *Calocoenia* is at least 1:0.2 and the M_{1+2} vein ratio is under 1:0.8. The male postabdomen is symmetrical; the epandrium is subelliptical with closely fused surstyli ventrally and with a median groove. The hypandrial process and aede-

agus are tusklike, long, and well sclerotized. The aedeagal apodeme is crescent shaped.

DESCRIPTION.— Length 3.4–4 mm; subshining to shining, metallic brown to greenish-brown; pollinose, gray ventrally.

Head. Mesofrons shining, bronze-gold metallic reflections; pectinate branches of arista not more than twice arisal width at base; pruinose face tan; interfoveol hump not as prominent as *Paracoenia* s. str., dorsally sloping; eye large, subcircular, width in profile double the length of projecting face in profile; eye-to-cheek ratio 1:0.25; width-to-height ratio 1:0.66; height-to-length ratio 1:0.9. Chaetotaxy of head and thorax like *Paracoenia* s. str. except acrostichal hairs.

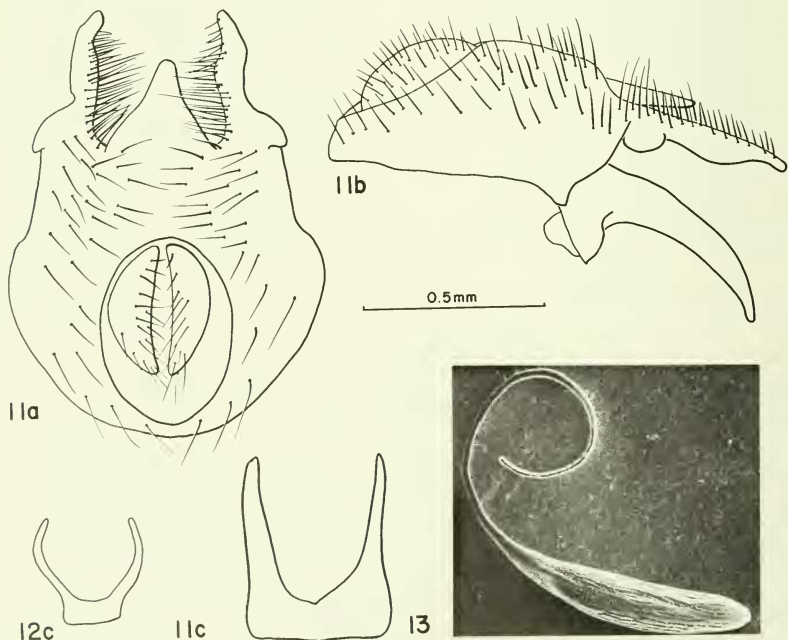
Thorax. Acrostichal hairs in two rows; dorsum pollinose to subshining; pleural areas concolorous with mesonotum centrally, becoming pollinose, grayed marginally; halteres yellow. Male mesofemora without comb of bristles. Wings with

costal bristles on dorsal and ventral margins; costal vein ratio 1:0.2.

Abdomen. Subshining to shining, brown metallic reflections; fifth abdominal tergite of male more or less truncate, without anteroventral process; fifth abdominal sternite with three posteriorly oriented prongs. Female postabdomen similar to *Paracoenia* s. str. Male postabdomen as in diagnosis, Fig. 7. Ventral receptacle with operculum wider than high, extending process considerably longer than operculum.

DISCUSSION.— *Calocoenia* is a monotypic subgenus known only from the Nearctic Region. Nothing is known about the biology of the included species.

Although the type-species of *Calocoenia* was originally described in *Paracoenia* s. str., its inclusion with the latter subgenus would form a paraphyletic grouping since the sister group of *Calocoenia* is *Leptocoenia*. The sister-group relationship with *Leptocoenia* is deduced from the joint pos-



Figs. 11-13.— Male genitalia and egg. 11 a,b,c *Paracoenia beckeri*; 12c *Paracoenia fumosa*; 13 stereoscan electron micrograph of *Paracoenia calida* egg, 100 X. Figures as in caption of 1-5.

session of the following apomorphic features not found in *Paracoenia* s. str.: eye-to-cheek ratio less than 1:0.3; interfoveal hump not as pronounced as in *Paracoenia* s. str.; and the fifth abdominal tergite lacking an anteroventral process.

Paracoenia (*Calocoenia*) *platypelta*
(Cresson)

Fig. 7, Map 1

Paracoenia platypelta Cresson, 1935, Trans. Amer. Ent. Soc. 61:356

Coenia (*Paracoenia*) *platypelta*: Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79:165

TYPES.— Male holotype, Pine Lake, So. Cal., Johnson. The type specimen also has a small label with the male sex symbol, Cresson's pink type label, and a red USNM type label, number 51110. The type is deposited with the U. S. National Museum of Natural History. Cresson's original description also lists a topotypical female paratype. I have examined this latter specimen, presently with the Academy of Natural Sciences of Philadelphia, and determined it as *Paracoenia turbida*.

DIAGNOSIS AND DESCRIPTION.— See generic description.

SPECIMENS EXAMINED.— 516

DISTRIBUTION.— This species is known only from the West (US). I have examined specimens from Washington to Alberta (Laggan) and southward to New Mexico, Arizona, and California. I have not seen specimens from Montana or Wyoming, although collection attempts have been made.

REMARKS.— *C. platypelta* is a very homogeneous species exhibiting little morphological variation. There is some color polymorphism, but this could represent age polymorphism. As mentioned previously, nothing is known regarding the biology or larvae of this species.

Leptocoenia, n. subgen.

TYPE-SPECIES.— *Coenia paurasoma* Sturtevant and Wheeler, monobasic

DIAGNOSIS.— *Leptocoenia* resembles *Calocoenia* but the body size is much smaller, length 2.1–2.6 mm, and the male postabdomen of *Leptocoenia* differs considerably. The surstyli are well separated apically with a small median triangular

process between them, which is very similar to a comparable structure in *Paracoenia* s. str. The triangular process in *Paracoenia* s. str., however, is better developed in comparison with the lateral surstyli. Externally, *Leptocoenia* is similar to *Calocoenia*, and both share the following character states: The acrostichal hairs are in two distinct rows; the scutellum is slightly flat; the ventral margin of the fifth abdominal tergite is not produced into a lobe; and the posteroventral surface of the mesofemora does not bear a row of comblike bristles.

DESCRIPTION.— Length 2.1–2.6 mm; dark brown, pollinose.

Head. Fronto-orbital areas, mesofrons nearly colorous, the later subshining; pectinate arisal branches at most two and one-half times arisal width at base; interfoveal hump not prominent, without pronounced dorsal indentation; pruinose face light tan; longest bristles along ventral margin of face approximately three-fourths length of interfoveal hump height; genal bristle weak, subequal to humeral bristles. Eye-to-cheek ratio 1:0.175; width-to-height ratio 1:0.65; height-to-length ratio 1:0.93; eye-width-to-face-length ratio 1:0.3.

Thorax. Lightly pollinose dorsally. Acrostichal setae in two rows; four pairs of dorsocentral bristles; humeral bristles present; halteres yellowish-brown to brown. Costal setae weak, developed only on dorsal margin.

Abdomen. Male postabdomen as in Fig. 9; ventral receptacle as in Fig. 9d.

DISCUSSION.— In many respects, this subgenus is pivotal, linking *Paracoenia* with *Coenia*. This is evident in characters associated with size and dimension, but the annectant role of *Leptocoenia* is best evidenced by the shape of the female ventral receptacle. The ventral receptacle closely resembles those of *Coenia* species and is probably less likely to be affected by selective pressure, which would bring about convergence in dimension and size of external characters except by pleiotropy. I attribute considerable importance to this feature and the relationship with *Coenia* that it demonstrates.

The internal male genitalia of *Leptocoenia* also reflect the intermediate position of this subgenus with *Coenia*. This is best seen by comparing Figs. 9e and 10e.

Paracoenia (*Leptocoenia*) *paurosoma*
(Sturtevant and Wheeler)

Fig. 9, Map 3

Coenia paurosoma Sturtevant and Wheeler, 1954,
Trans. Amer. Ent. Soc. 79:165

Paracoenia paurosoma: Wirth, 1965, USDA Agri.
Handbook No. 276, p. 567

TYPES.—Female holotype, three paratypes (one male, two females), Lander, Wyoming, 16 August 1950. The holotype also bears a collector label, M. R. Wheeler, and type number 6696. A fourth paratype (female), Rainbow Lake, Colorado, elev. 10,200', 50 hl. The original description indicates that K. W. Cooper was the collector of the fourth paratype, but no collector label accompanied the specimen. The holotype is deposited with the Academy of Natural Sciences of Philadelphia, two paratypes with the U.S. National Museum of Natural History, and two paratypes with M. R. Wheeler.

DIAGNOSIS AND DESCRIPTION.—See generic description.

SPECIMENS EXAMINED.—41

DISTRIBUTION.—*Paurosoma* has been collected from Colorado north through Wyoming, Alberta (Laggan), and into Alaska (Matanuska Flats). I have also examined five specimens from Sweden (Norrbotten, 3 km N Messaure).

Although *paurosoma* is Holarctic, it was the most recently discovered species. Moreover, nothing is known about its biology. The habitat of this species is montane; at lower latitudes it is found at elevations up to 10,500 feet (Rainbow Lake, Colorado).

Genus *Coenia* Robineau-Desvoidy

Coenia Robineau-Desvoidy, 1830, Essai sur les Myodaires 2:800. Type-species *Coenia caricicola* Robineau-Desvoidy (= *Ephydra palustris* Fal-lén), by monotypy; Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79:164-166 (review of Nearctic species as subgenus of *Coenia*); Wirth, 1965, USDA Agri. Handbook No. 276, pp. 755-756 (catalog)

Caenia emendation: Walker, 1853, Insecta Britanica Diptera 3:259 (preoccupied-Newman, 1853, Entomological notes. Art X. Ent. mag., pp. 372-402, Coleoptera)

DIAGNOSIS.—*Coenia* species resemble those of *Paracoenia*, especially the subgenus *Leptocoenia*, but they are differentiated as follows: Dorsalmost postocular bristles not subequal to the verticals; no

well-developed humeral bristles; two pairs of dorsocentral bristles; halteres brownish-yellow to dark brown; and fifth abdominal sternite of males longer than wide. The size of *Leptocoenia* is within the dimensions of *Coenia*, and superficially they appear very similar. However, the chaetotaxy characters readily distinguish either and set the *Coenia* species apart from any *Paracoenia* subgenus.

DESCRIPTION.—Length 2.2-2.8 mm; dark brown, pollinose to subshining.

Head. Mesofrons subshining with metallic reflections; postocular bristles weak, at most slightly larger than their distance apart as base; postorbital bristles usually weak; pectinate arisal branches various; bristles of face comparatively large, bristles along ventral margin subequal in length to interfoveal hump height; facial pruinosity various; chaetotaxy of head similar to *Paracoenia* except as noted. Eye relatively large, subcircular although higher than wide; width-to-height ratio 1:0.62; height-to-length ratio 1:0.95; eye-width-to-face-length ratio 1:0.3.

Thorax. Dark brown, generally concolorous; strength of pollinose covering various. Acrostichal hairs in two rows, indistinct in some species. Three or four pairs of dorsocentral bristles; humeral bristles various; otherwise chaetotaxy as in *Paracoenia*. Wings without prominent costal bristles, at most weakly developed on dorsal margin; costal vein ratio 1:0.3; M_{1+2} vein ratio 1:0.7. Legs uniformly dark brown; male mesofemora without posteroventral comb. Halteres as in diagnosis.

Abdomen. Subshining to shining dark brown; male with five visible tergites; female with six to seven; male with five sternites; fifth sternite narrowed to small strip; spiracle arrangement as in *Paracoenia*. Male postabdomen with surstyli closely apposed basally, becoming well separated on apical 2/3; aedeagal apodeme broad to narrowly crescent-shaped; aedeagus curved, pointed apically. Ventral receptacle with small operculum, extending process C-shaped.

DISCUSSION.—Of the three known *Coenia* species, one is apparently endemic to the Nearctic Region, a second is limited to the Palearctic, and a third species is Holarctic. Cresson's comments regarding the European species and their distinguish-

ing characteristics should be consulted for species separation from that fauna.

Species of *Coenia* are not usually associated with aquatic environments that are contaminated or contain high concentra-

tions of various salts. Dahl (1959) and Scheiring and Foote (1973) report on associations of *Coenia curvicauda* (Meigen) with mud shore habitats and to a lesser extent with the limnic wrack.

Key to *Coenia* species

1. Male genitalia large, exposed ventrally; epandrium over twice as long as wide, with median suture *C. curvicauda* (Meigen)
- Male genitalia more compact, not exposed; epandrium less than twice as long as wide, without median suture *C. alpina* n. sp.

Coenia alpina, n. sp.

Fig. 10, Map 2

DIAGNOSIS.—*C. alpina* most closely resembles *C. palustris*, a Palearctic species. It is distinguished from the latter by differences in male genitalic structures. The surstyli are proportionately shorter to the epandrial length, the aedeagus is deeper and ventrally rounded, the aedeagal apodeme is longer, and the hypandrial processes are thinner and project mesad to the hypandrial connection with the aedeagus. The females of both species are very similar.

DESCRIPTION.—Length 2.1–2.6 mm; dark brown with some purplish metallic reflections dorsally.

Head. Interfoveal hump more or less prominent; pruinose face brown; pectinate branches of arista long, approximately three times arisal width at base; post-orbital setae not developed dorsally. Eye-to-cheek ratio 1:0.12; width-to-height ratio 1:0.6; height-to-length ratio 1:0.96; eye-width-to-face-length ratio 1:0.33.

Thorax. Acrostichal setae weak, in two rows; three pairs of dorsocentral bristles; humeral bristles absent; halteres dark brown.

Abdomen. Subshining to shining with some purplish reflections; ventral receptacle as in Fig. 10d; male genitalia as in Fig. 10.

DISTRIBUTION.—*C. alpina* has been collected in Colorado (Rabbit Ears Pass), in the Northwest Territories (Aklavik), and in Labrador (Cartwright).

TYPES.—Male holotype, allotype, and 21 paratypes (8 males, 13 females), Cartwright, Labrador, 29 June 1955, E. F. Cashman; 17 paratypes with same data as type except as follows: 5 males, 3 females, 3 July 1955; 4 males, 2 females, 2 July 1955, E. E. Sterns; 1 male, 6 August

1955, E. E. Sterns; 1 male, 12 August 1955. The type, allotype, and 32 paratypes will be deposited with the Canadian National Collection, type number 13435. A male and female paratype also will be deposited with the California Academy of Sciences, the U.S. National Museum of Natural History, and in my collection.

In addition to the type series, I have examined 31 specimens of this species from the following localities: 9 males, 17 females, Aklavik, Northwest Territories, May–August 1930 and 1931; 2 males, 3 females, Rabbit Ears Pass, Colorado, 11 June 1968, S. L. W.

REMARKS.—This species is alpine, which accounts for the specific name. Although the known distribution is based on minimal data that is rather disjunct, I feel that *C. alpina* is distributed throughout the Rocky Mountains at higher elevations and across northern Canada.

From my study, I have found very little variation except for minor size differences as indicated in the description. Otherwise, *C. alpina* seems to be a very uniform species.

Coenia curvicauda (Meigen)

Fig. 8, Map 3

Ephydra curvicauda Meigen, 1830, Syst. Besch. 6:116

Coenia curvicauda: Macquart, 1835, Hist. Nat. Ins. Dipt. 2:530

TYPES.—Cresson (1930) designated a lectotype for this species from material in the Naturhistorisches Museum, Wien. According to Cresson, the male lectotype has the following label data: "curvicauda Coll. Winth," "curvicauda." A second male specimen with similar data was designated a paratype by Cresson.

DIAGNOSIS.—*C. curvicauda* is similar to *C. alpina* and to *C. palustris* but differs

from either by the well-developed male postabdomen which protrudes from the venter of the abdomen. The epandrium plus surstyli are over twice as long as the epandrial width, and the epandrium is divided by a median groove. The surstyli arms are longer than their base, the aedeagal apodeme is slender and C-shaped in profile, and the aedeagus is broadly developed basally and curves forming a J-shaped structure.

DESCRIPTION.— Length 2.3–2.8 mm; dark brown, subshining to shining.

Head. Mesofrons shining, dark brown; fronto-orbital areas subshining; pectinate arisal branches subequal to third antennal segment width; face lightly pollinose, mostly dark brown; chaetotaxy as in *C. alpina*; eye-to-cheek ratio 1:0.11; width-to-height ratio 1:0.6; height-to-length ratio 1:1; eye-width-to-face-length 1:0.3.

Thorax and abdomen as in *C. alpina* except as given in diagnosis.

SPECIMENS EXAMINED.— 150

DISTRIBUTION.— *Coenia curvicauda* is a Holarctic, boreal species. In the Nearctic region it is found in Montana (Bigfork) and east through the Midwest to the Northeast. It extends north to Alaska (Tonsina) and east to Quebec (Cross Point).

REMARKS.— Although I did not examine the lectotype, I have studied European specimens of this species. The aedeagus in some specimens does not curve apically to the extent found in Nearctic specimens, but I did not find any other major differences. I consider all specimens I examined to be conspecific.

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